

Coordinated Micro-sampling with Clean-Chemistry for Isotopic Analysis

Completed Technology Project (2012 - 2013)



Project Introduction

The proposed milestones will strongly enhance the ability of ARES scientists to study the ancient materials expected to be returned by future robotic, and eventually human, exploration missions. Mn-Cr isotope measurements can be used to determine the formation age of ancient planetary and pre-planetary materials and their distribution in the Solar System. ^{54}Cr isotope "anomalies" extant at the time of the origin of the solar system can be used to trace the distribution of solid matter as it is potentially transported across the protoplanetary disk eventually accreting to make the building blocks of terrestrial planets. This work will establish ultra-clean chemical purification and isotopic analysis of chromium and manganese in sub-milligram-sized astromaterial samples. Newly developed mass spectrometry techniques will be implemented to determine precise Mn-Cr formation ages and to make Cr isotopic measurements of sample-limited materials. Micro drilling techniques will be established to facilitate high precision measurements of sample targets that require high spatial resolution. Chemical dissolution and purification will be tested in a controlled, well tested manner under class 1000 clean-lab environment.

Manganese-chromium isotopic analysis can be used to determine the age of ancient (>4.5 billion year old) dust and rock fragments, as well as for mapping in space and time the distribution of primordial material in the protoplanetary disk, in particular during the early accretion period of asteroids. This laboratory-based research will be coordinated with our microMill sampling facility and state-of-the art Triton thermal ionization mass spectrometer (TIMS). This work will develop the high precision analysis processes of ultra small samples of the type that will be returned by robotic and, eventually, human exploration missions to asteroids. We will also integrate microMill sampling, chemical purification, and TIMS analysis of small targeted regions of larger samples (e.g., core and/or rims of minerals contained in rocks returned from differentiated asteroids, the Moon, and/or possibly ancient rocks from Mars). At the completion of this multi-year project ARES scientists will have well-developed, calibrated, and fully-documented sets of: (1) low blank micro-dissolution vessels and (2) of micro-columns to efficiently purify Mn and Cr from future small returned samples, as well as an ultra-clean workspace to conduct these experiments. In short, we propose to have all sample procedures and laboratory spaces prepared and tested prior to any future Mission-related sample allocation. This work will strongly enhance the quality of science results obtained from the tiny particles expected to be returned by robotic, and eventually human, exploration missions.

Anticipated Benefits

N/A



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

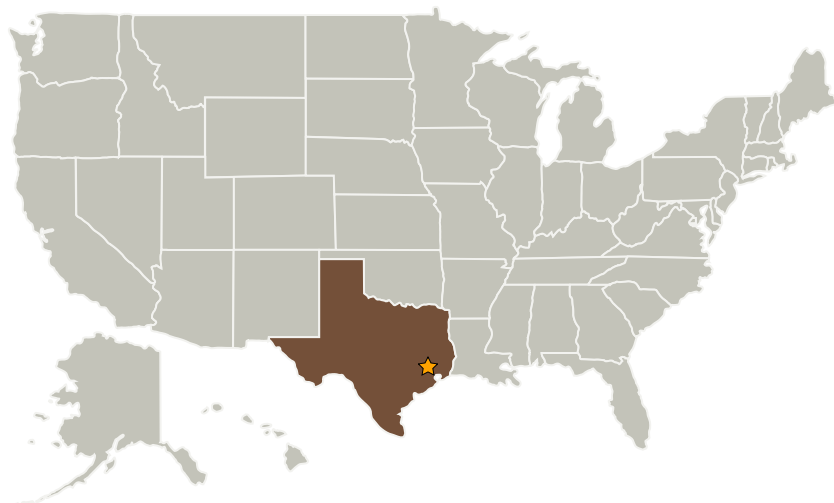
Center Innovation Fund: JSC CIF

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Jacobs Engineering Group, Inc.	Supporting Organization	Industry	Dallas, Texas

Primary U.S. Work Locations

Texas

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Carlos H Westhelle

Project Manager:

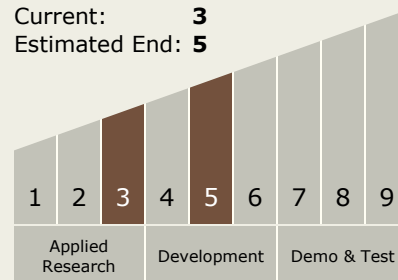
Justin I Simon

Principal Investigator:

Justin I Simon

Technology Maturity (TRL)

Start: 3
Current: 3
Estimated End: 5



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - TX08.3 In-Situ Instruments and Sensors
 - TX08.3.3 Sample Handling